CAES NEWS
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CAES director honored for work in promoting energy education

By Kortny Rolston, CAES Communications

When the Partnership for Science and Technology started planning this year's energy advocate awards banquet, officials realized they were missing a key category.

They honored national, regional and local energy advocates and even had a special nuclear energy award. But there was nothing for those who support energy education.

So they created one. Center for Advanced Energy Studies Director Harold Blackman is the first recipient of the organization's energy education advocate award.

"We realized as a group that CAES will play a vital role in the research for new energy options and in the training of engineers, technicians and other workers needed in that industry," said Lane Allgood, the nonprofit's executive director. "Dr. Blackman has worked hard to make CAES what it is and promote energy education."

Blackman received his award Dec. 19 along with several other individuals and groups who received awards, including prominent INL researcher, Dr. Steve Herring.

One of CAES' primary missions is to increase the number of students entering the energy field. Four years ago, University of Idaho, Boise State University and Idaho State University, all partners in CAES, had fewer than 20 students majoring in nuclear energy-related fields. Now, they have more than 200.

Several people supported Blackman's nomination, including INL Director John Grossenbacher and the vice presidents of research at Idaho State University, Boise State University and University of Idaho, all of whom are partners in CAES.

"Over the past three years (Blackman) has worked tirelessly to cement the CAES partnership, to build competitive energy research programs, to attract bright graduate students and outstanding faculty to Idaho's universities, and to reach out across Idaho to promote an informed energy policy dialogue," their nomination letter stated.

Blackman said it was an honor to be chosen for the award, especially since this is the first year the Partnership for Science and Technology has offered it.

"CAES has been successful because of the fantastic collaboration that exists among the partners and of course the support that has come from the state, community and organizations like PST," he said. "It is pleasure to serve in a leadership role with the quality individuals that make up the CAES Team. We have much to look forward to in the future."

Did you know?

The Partnership for Science & Technology is a nonprofit organization that advocates for advancement of science, energy and technology. It also provides accurate information on energy-related regional activities including those at Idaho National Laboratory.

To learn more, visit www.partnershipforscienceandtechnology.org

Fighting climate change by turning CO_2 to stone

By Michael Wall, INL Communications

While politicians debate the best ways to cut global carbon dioxide emissions, researchers at the Center for Advanced Energy Studies are charging ahead on a strategy to defuse the CO_2 the world already produces. They want to inject the greenhouse gas deep underground, where it would react with rocks and remain, entombed, for thousands of years.

CAES scientists have been studying this novel approach — called mineral sequestration — for years. They have characterized promising injection sites and run many computer simulations to understand how the process works. But they will soon ramp up their efforts dramatically, thanks to collaborations with international research groups, newly installed lab equipment and a recently awarded $750,000 grant. The CAES team will play a key role in determining if mineral sequestration is a viable strategy for mitigating the impact of climate change — or just a pipe dream.

"The next year ought to be pretty exciting for us," says geochemist Travis McLing, INL's technical lead for carbon capture and sequestration. "The rubber should really hit the road."

What to do with all that CO_2?

Over the past 150 years, atmospheric levels of heat-trapping CO_2 have increased by 35 percent, chiefly as a result of intense fossil-fuel use. During this same period, average global temperatures have risen by 0.6 to 0.9 degrees Celsius. Many climate scientists have long argued that the world risks a climate catastrophe if it continues to pump out so much CO_2, and politicians have begun to agree that something needs to be done.

The ultimate goal is to switch the global energy economy over to cleaner, greener sources. But this fix is years down the road and fraught with economic and technological hurdles. In the short term, burning fossil fuels is far cheaper than developing renewable energy resources (such as solar and wind) or building more nuclear power plants. Petroleum, coal and natural gas still generate 84 percent of the energy consumed in the United States, according to the Department of Energy's Energy Information Administration. And the EIA estimates that global CO_2 emissions will grow by 1.4 percent every year through 2030 (link to EIA page).

But not all CO_2 we produce has to end up in the atmosphere. Carbon dioxide generated by "point sources" such as power plants — as opposed to more dispersed emitters like cars and planes — can be captured before it leaves the smokestack. This CO_2 can then be injected hundreds or thousands of meters underground, sealed safely away for many years.

Some scientists believe this strategy, termed carbon capture and sequestration (CCS), could help the world buy some time while it figures out a long-term energy solution. And CCS has moved beyond the realm of the purely theoretical. StatoilHydro, a Norway-based energy company, has been injecting 1 million tons of CO_2 underground annually since 1996.

A more permanent solution

StatoilHydro injects CO_2 into porous sandstone 800 meters (about 2,600 feet) beneath the North Sea floor. The overlying rock is gas-tight, the company says. But some researchers, such as McLing and fellow INL scientist Rob Podgorney, would prefer to remove any possibility that CO_2 could escape back into the

In CAES you didn't know...

The economic downturn has taken a heavy toll on Idaho's three largest research institutions – Boise State University, Idaho State University and University of Idaho.

All have slashed costs to help the state make up the shortfall in its FY 2009 budget. And Gov. C.L. "Butch" Otter warned that more cuts may be coming if the state's revenues do not improve.

This grim economic news came just weeks before CAES and its partners met in Sun Valley for a strategic planning session and pervaded much of the discussion.

Our university partners worried what another year of recession could do to their programs and their ability to collaborate with CAES.

Despite these concerns, all of the university representatives present – professors and vice presidents of research alike – reaffirmed their commitment to the CAES partnership. They vowed to keep CAES going even during these uncertain times.

They also acknowledged that while each institution has its strengths, their ability to collaborate through CAES has led to much greater success. Together, they are able to compete with much larger universities for research dollars.

It was a vote of confidence for CAES and remarkable given the circumstances the universities and the state face. It's not easy to collaborate with colleagues hundreds of miles away and also teach classes and oversee projects at your home campus.

We appreciate their commitment. Without them, CAES would not have experienced the success it has to date. And like them, we also are committed to making this collaboration work.

Harold S. Blackman

Harold Blackman, CAES Director

atmosphere. That's why they're working on the mineral sequestration side of CCS. Their goals are both fundamental and ambitious.

"We want to know what exactly is going on underground when you inject CO_2," Podgorney says.

The basic theory is well understood. Certain types of rock, such as basalt, are rich in metallic ions like calcium, magnesium and iron. When CO_2 is injected deep into basalt formations, it dissolves in water and reacts with these ions to produce carbonate minerals (such as calcium carbonate). CO_2 is thus locked into solid rock that will be stable permanently.

The potential of this process is huge — basalt makes up about 65 percent of the Earth's crust. According to a recent paper in the journal Energy Procedia, the Juan de Fuca tectonic plate off the United States' northwest coast could suck up 700 billion tons of CO_2 by itself — far more than the 33 billion tons produced by humans every year.

McLing, Podgorney and their colleagues — researchers at the University of Idaho and Idaho State University, all working together under the CAES umbrella — are among a few groups in the world investigating mineral sequestration in depth. The CAES scientists have drawn up models predicting how the approach would work, filling in key details by studying the basalt fields underlying Idaho's Snake River Plain. Their simulations are encouraging, Podgorney says: large volumes of deeply injected CO_2 should mineralize within a decade or two, long before the gas has a chance to seep out into the atmosphere or into overlying freshwater aquifers.

And the team is now set to take the crucial next step: testing its models with data from experiments around the world. In September, McLing and Podgorney gave invited talks at a CCS conference in Iceland. In addition to munching hors d'oeuvres at the home of Iceland's president, they shared ideas with key members of the CarbFix project (link to CarbFix page). CarbFix — a collaborative effort led by the University of Iceland, Columbia University, Reykjavik Energy and France's National Center for Scientific Research — will be the world's first large-scale test study of mineral

sequestration in basalt. CarbFix will dissolve a load of CO_2 in water — speeding things up, since it can take a long time for this to happen underground — then inject the seltzer solution about 600 meters (2,000 feet) deep in Icelandic basalt. CarbFix plans to sequester 2,000 tons of carbon dioxide in this manner every year to study mineralization rates and the extent of CO_2 leakage. And all of this should start happening within a month or two.

While INL's logo does not yet appear on CarbFix brochures, that may change.

"We'll probably formalize a collaborative relationship soon," McLing says. In any event, the CAES researchers will soon have access to CarbFix data and water samples, which they can use to firm up their models.

Validating the models

"It's your classic murder mystery," McLing says of water sample analysis. "You find the body and try to figure out what happened."

McLing cracks cases by determining what elements and minerals are dissolved in his samples. Water picks up different chemical signatures as it moves from one type of rock to another. Fleshing out these signatures can reveal where the water's been and how quickly certain chemical reactions — such as the ones that turn CO_2 into stone — have taken place.

McLing and Podgorney hope to analyze enough samples to figure out definitively how CO_2-saturated water moves through basalt. This in turn will help

them determine if their carbon mineralization models need tweaking. By early 2010, they should have samples from the CarbFix project in hand — bubbly seltzer from injection areas as well as normal water from control sites, giving the scientists both experimental and baseline data.

By the summer of 2010, the team will also start collecting water samples right from INL's backyard. In September, a major multinational corporation granted McLing and his colleagues $750,000 to conduct a three-year sequestration study at Soda Springs, a small town 60 miles southeast of Idaho Falls. At Soda Springs, naturally carbonated water flows over, under and through basalt very similar to the rock formations found at CarbFix's Iceland site.

"Soda Springs is a natural analogue," McLing says. "We'll collect water from every window we can sample there."

And McLing and Podgorney hope to supplement these samples with water from another site in eastern Washington, where Pacific Northwest National Laboratory (link to PNNL page) plans to lead an injection study similar to CarbFix in the near future.

The CAES scientists are analyzing mineral sequestration from another angle as well. Any day now, a set of 8-vessel pressure systems that the team ordered months ago will be delivered to their lab. This new equipment will allow them to recreate the temperatures and pressures found at potential sequestration depths in basalt. So McLing and Podgorney will have another way to gather data, another tool to test their models and improve their understanding of how mineral sequestration works — and whether it could work on a large scale.

"The point is to get our arms around all of these things, to close the circle," Podgorney says.

Not a silver bullet

Though mineral sequestration shows a great deal of promise, research into the approach is still in its early stages, and many complicating factors remain. Chief among these is cost, a problem for all forms of CCS technology. Scrubbing CO_2 from smokestacks, processing it and transporting it to injection sites would chew up about 25 percent of a typical coal-fired plant's energy output, McLing estimates. So for every three new plants built with carbon capture capabilities, a fourth would be needed just to power the CCS process.

This energy cost translates to a high economic cost as well. McLing says it is likely that no form of CCS is practical in the U.S. without a government-imposed price on CO_2, likely somewhere between $50 and $100 per ton. StatoilHydro, for example, only began its CCS operations after Norway implemented a CO_2 tax of $55 per ton. The company's CO_2 injections now save it $55 million every year.

Also, CCS would only work at point sources such as power plants, which are responsible for about half of the world's human-caused CO_2 emissions. Carbon dioxide from cars, trucks, boats and planes would still waft into the atmosphere in huge volumes. For these reasons, the U.S. Geological Survey stresses that CCS is a "necessary but insufficient" measure to control atmospheric CO_2. Alternative energy development and conservation, among other strategies, will also be required to get the climate-change problem under control.

McLing and Podgorney, however, are focusing on the positive: that capture and sequestration can be a big part of the solution. And they're excited about the future of mineral sequestration.

"There's an awful lot of energy in the field right now," McLing says. "The doors are really beginning to open."

CAVE Construction at CAES

By Kortny Rolston, INL Communications & Governmental Affairs

Construction crews are remodeling laboratory space on the second floor of CAES to make way for a CAVE.

A CAVE - short for computer automated virtual environment - creates highly realistic interactive simulations in which researchers can examine designs, data or environments. It can also be used to virtually train operators and technicians.

In addition, CAES is adding a portable, single-screen visualization environment which tracks the position of the viewer continuously as it renders the 3-D objects. This virtual reality workstation is similar to the CAVE, which will be installed in CAES this spring.

The Center for Advanced Modeling and Simulation (CAMS), which will oversee both systems, will be giving a demonstration of the new single-screen virtual reality system to INL researchers in a few weeks.

Center for Advanced Energy Studies nearly triples research funding goal

By Kortny Rolston, INL Communications & Governmental Affairs

When Gov. C.L. "Butch" Otter toured the Center for Advanced Energy Studies building last fall, CAES officials promised him the research partnership would pay off.

Then, they gave him a number.

"We made the commitment that CAES would bring in $5 million in new research money," CAES Director Harold Blackman said. "We wanted him to know we were serious about providing the state and the other CAES partners with a return on their investment."

In the months since, CAES has delivered on that promise and then some. From July 1, 2008, to May 31, 2009, it brought in $13.9 million in research and other funding.

"We're very excited to have done so well," Blackman said about the public/private partnership between Idaho National Laboratory, the Department of Energy and the state of Idaho through its three public research universities, Boise State University, Idaho State University and University of Idaho. "We almost tripled our goal."

Much of the money is for nuclear-related research, including projects for the Electric Power Research Institute and the U.S. Nuclear Regulatory Commission. And Idaho State University, University of Idaho and Boise State University, all CAES partners, competed for and won $5.8 million for various research proposals through a DOE Office of Nuclear Energy program for colleges.

Not all the research funding was nuclear-related, however. CAES signed a $3.1 million agreement with a company to commercialize one of its first major research projects on precision nanoparticles, which also won a prestigious R&D 100 Award.

And CAES partnered with two universities, Boise State and Utah State, to win a $20,000 grant from the National Science Foundation. The funding will help them explore forming a regional industry/university cooperative to conduct radioactive materials research.

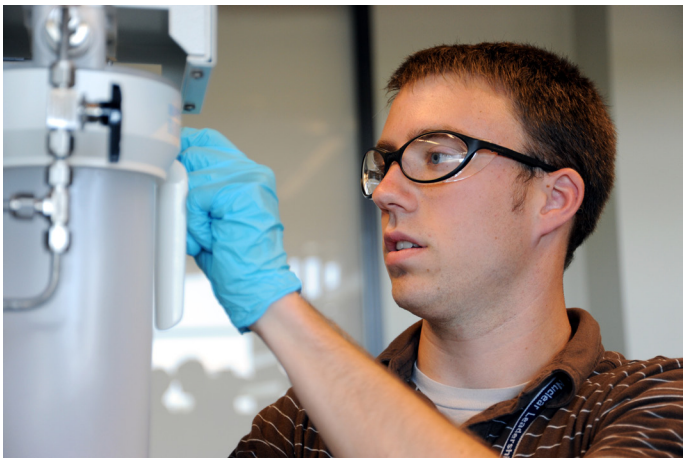
Otter congratulated CAES for surpassing its goal.

At a recent Greater Idaho Falls Chamber of Commerce luncheon, Otter pointed to CAES as one of the bright spots in Idaho's otherwise struggling economy. He called investing in CAES a "leap of faith" that has paid off for Idaho.

"What's happening at CAES is a great example of what can be accomplished when we focus our complementary talents on our shared goals," he said. "All of Idaho is better off for having CAES working with researchers at our universities to advance the goals of energy independence and economic opportunity. It's a partnership with tremendous promise, and which already is delivering."

Its research is focused on bioenergy, carbon management, energy policy, and materials and nuclear science and engineering.

Gov. C.L. 'Butch Otter' recently called Idaho's investment in CAES 'a leap of faith' that has paid off for the state.



INL intern Tanner Hesse assembles equipment that CAES scientists are using to conduct research for the Electrical Power Research Institute.

To submit story ideas, calendar items or other information for upcoming CAES newsletters, please send an e-mail to Kortny.Rolston@inl.gov.